Initial Solids Removal Plan

Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01 Rico, Colorado

Atlantic Richfield Company

Chuck Stilwell, P.E. Project Manager

900 E. Benson Blvd. Anchorage, Alaska 99508 (907) 564-4608 (406) 491-1129 (cell) Chuck.Stilwell@bp.com

May 2, 2011

Mr. Steven Way
On-Scene Coordinator
Emergency Response Program (8EPR-SA)
US EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: Initial Solids Removal Plan

Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01 Rico, Colorado

Dear Mr. Way,

Please find enclosed three (3) copies of the *Initial Solids Removal Plan* dated May 2, 2011. Atlantic Richfield is submitting the *Plan* in accordance with Section 5.2.1 of the Removal Action Work Plan, Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01 Rico, Colorado dated March 9, 2011.

If you have any questions, please feel free to contact me at 406.491.1129.

Sincerely,

Chuck Stilwell, P.E.

Project Manager

Atlantic Richfield Company

Enclosures

cc: R. Halsey, AR

S. Dischler, AR

T. Moore, AR

C. Sanchez, Anderson Engineering

T. Kreutz, AECOM (w/o encl.)

D.Yadon, AECOM (w/o encl.)

J. Decker, AECOM (w/o encl.)

Table of Contents

1.0	Introduction		1
	1.1	Purpose	1
	1.2	Scope	1
	1.3	Precipitation Solids Inventory	
	1.4	Pond 18 Solids Characteristics	
2.0	Solid	ds Removal	4
3.0	Interim Drying Facility		5
	3.1	Siting	
	3.2	Interim Drying Facility Layout	
	3.3	Drying Cell Conceptual Design and Operation	
4.0 5.0	Evaluation of Removal Methods and Drying Cell Performance		8
	Schedule and Oversight		<u> </u>
	20		

List of Figures

- Figure 1 Location Map
 Figure 2 Initial Solids Removal and Interim Solids Drying Site
 Figure 3 Conceptual Interim Solids Drying Facility Plan
 Figure 4 Conceptual Interim Solids Drying Facility Sections

1.0 Introduction

1.1 Purpose

This Initial Solids Removal Plan (Plan) addresses the overall removal and drying of solids from all of the upper ponds at Operable Unit OU01 of the Rico-Argentine Mine Site – St. Louis Tunnel (Site) responsive to the requirements of Section 5.2.1 of the Removal Action Work Plan, Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01 Rico, Colorado dated March 9, 2011 (see Figure 1 for Site location). As described below, this Plan focuses on the near-term removal of solids at Pond 18 and construction and operation of an interim drying facility. This initial removal and interim drying of existing solids from Pond 18 will also provide a field-scale opportunity to evaluate the best means and methods for removal and drying of existing solids from the remaining upper ponds as well as for future solids to be generated during long-term operation of the currently envisioned ponds treatment system. A general plan and schedule for all initial solids removal is provided, but will be refined upon evaluation of the Pond 18 solids removal. This initial solids removal will result in the majority of existing pond solids being moved from the active settling ponds of the treatment system, and ultimately being placed in a secure on-site repository.

1.2 Scope

A substantial portion of the existing precipitation solids and sediments (hereinafter typically referred to as solids) in the upper ponds (Ponds 18, 15, 14, 13, 12 and 11 – from north to south) will be removed, dried, and eventually disposed of in a future on-site repository. The solids removal will begin in the summer of 2011 at Pond 18 and placement of solids in an on-site solids repository will be completed no later than December 2014 as described more fully in Section 5.0 below.

The currently envisioned means and methods of removal and interim drying of Pond 18 solids are described in conceptual terms in this Plan. The actual means and methods utilized will be determined in the field based on: current site conditions in Pond 18 and at the interim drying facility site; weather conditions during the removal and interim drying period (precipitation, evaporation and wind); and the performance of the interim drying facility.

An interim drying facility will be constructed in summer 2011 to allow drying and storage of the portion of the existing solids to be removed from Pond 18, pending construction of the planned on-site solids repository. The solids in the remaining upper ponds will be processed in the interim drying facility, or a permanent drying facility to be constructed together with the solids repository, depending on when they are removed.

The interim drying facility will be constructed with up to four (4) separate cells to facilitate full-scale testing of alternative drying methods and also provide information valuable to designing a permanent drying facility and establishing operational procedures. Data will be collected and observations documented for the major elements of the removal and interim drying processes during the initial Pond 18 solids removal. The means and methods of solids removal and drying will be modified for subsequent solids removal, as appropriate based on the field experience gained during the Pond 18 removal this summer.

1.3 Precipitation Solids Inventory

Precipitation solids have accumulated in the upper ponds (Ponds 11-15 and 18) at the Site as a result of precipitation and settling of metal complexes by natural processes and by prior addition of lime to the St. Louis Tunnel discharge from approximately 1984 to 1995. It is also possible that some amount of sediment eroded from the floor of the underground workings in the St. Louis Tunnel and/or from the bed and walls of the open channel outside the tunnel have been conveyed by the St. Louis Tunnel discharges to Pond 18 and possibly to the other upper ponds.

An inventory of existing solids was performed in 2001¹ by precision surveying utilizing a sampling boat outfitted with a survey prism and depth sounding rods. A total of approximately 34,200 cubic yards (cy) of solids was estimated from that work (not including material in Pond 13 or calcine tailings found at the bottom of Pond 15 as discussed below). The estimated volume of solids as of the time of the 2001 surveys in each of the upper ponds investigated is summarized as follows:

- Pond 18 20,000 cubic yards (see discussion below regarding current estimated volume)
- Pond 15 11,000 cubic yards (see discussion below regarding calcine tailings beneath solids)
- Pond 14 2,600 cubic yards
- Pond 13 not inventoried (see discussion below with estimate of current solids volume)
- Ponds 11 and 12 10,600 cubic yards

Following the original survey of sediment volumes in 2001, water flow was re-routed around Pond 18 to allow the pond to dewater for approximately 10 months (as discussed in Section 1.4 below) and the solids were observed to consolidate in place. Also, a small volume of solids was removed for use in the pilot scale test cells in Ponds 16/17 in 2002. Water was again re-routed around Pond 18 in late fall 2010 and has continued to bypass the pond to present (approximately 5 months to date). Based on a recent survey of the surface of the solids in Pond 18 performed in April 2011 and the original pond bottom probing performed in 2001, it is estimated that Pond 18 currently contains approximately 13,000 cubic yards of solids (see additional discussion in Section 1.4 below).

Sampling of the full section of material in Pond 15 during the 2001 investigation revealed that the total amount of material in the pond was approximately 19,000 cy, of which approximately 40-45 percent (or about 8,000 cy) was calcine tailings underlying the precipitation solids. There was also an indication of a minor amount of calcine tailings at the bottom of Pond 18 but not enough to merit separate accounting.

The exposed surface of the material in the periodically unsubmerged portion of off-line Pond 13 appears to be comprised of precipitation solids. The nature of the materials at depth in Pond 13 is unknown. Review of boring and test pit logs in the dikes surrounding the pond indicate that the earthfill is locally mixed with some calcine tailings. This suggests the

_

¹ Unpublished file information prepared by SEH, Inc.

possibility that some portion of the materials below the solids exposed at the surface in Pond 13 may be calcine tailings, as was found in prior sampling in Pond 15. Given the very soft condition of the exposed near-surface materials and the very shallow water depth on the submerged portion of the pond during the 2001 surveys, Pond 13 could not be safely accessed for depth measurement or sampling. In the absence of survey/probe data, the order of magnitude volume of material in Pond 13 has been estimated as 20,000 cy based on topographic spot elevations in the unsubmerged portion of the pond from a pre-1995 topographic map of the Site and an estimate of the elevation of the pond bottom extrapolated from data in the adjacent probed ponds.

Relatively few settled solids were observed below Pond 11 and those ponds are not included in the removal, drying and repository storage plans for the Site.

An overall plan and hydraulic profile of the portion of the pond system encompassing the upper ponds is shown in Figure 2. Based on prior site geologic and geotechnical investigations, it is inferred that the bottom of Pond 18 was excavated into underlying predominantly coarse-grained (sand, gravel and cobble) alluvial aquifer deposits. Measurements of water levels in monitoring wells adjacent to Pond 18, as supported by readings in temporary piezometers installed during field investigations in 2001-2002, indicate that the depth to groundwater within the pond solids has varied from the top surface to near the bottom of the solids on a seasonal and climatic (drought versus wet period) basis. Recent measurements over the past 10 months of the nearest monitoring wells indicate that groundwater levels were highest in July and lowest in December-March. The highest groundwater levels project to about two (2) to three (3) feet above and the lowest levels about at the average bottom elevation of solids in Pond 18.

1.4 Pond 18 Solids Characteristics

Paser (1996)² recovered piston-style core samples of the solids from Pond 18, which at that time were approximately 8 feet thick. Subsequent detailed grid probing in 2001 indicated an average sediment thickness of 10.5 feet.

Based on previous testing in 2002³ of minimally disturbed core samples from Ponds 11, 12, 14, 15 and 18 acquired in 2001, the settled precipitation solids (prior to any in-pond consolidation by dewatering during low groundwater periods) are estimated to have a weighted average solids density (weight of dry solids/total wet weight) of 12.9 percent and an average specific gravity of 2.42. Following a planned dewatering exercise from September 2001 to June 2002, which included a winter groundwater level at or below the base of Pond 18, the average bulk unit weight of the solids was estimated as 23 pcf. Based on a recent survey of the top of solids in Pond 18 made in April 2011 and the 2001 pond bottom contours, it is estimated that there are approximately 13,000 cubic yards of solids in Pond 18, and that the average thickness of the solids is on the order of four (4) to five (5) feet.

Hydraulic conductivity testing of the solids has not been performed due to the significant physical access challenges and safety concerns of working on water over the solids or

² Paser, Kathleen S. 1996. Characterization of and Treatment Recommendations for the St. Louis Adit Drainage and Associated Settling Ponds in Rico, Colorado: MS Thesis, Colorado School of Mines. August 30.

³ Unpublished file information prepared by SEH, Inc.

accessing equipment directly on the very soft solids surface where unsubmerged. Estimates of permeability of the in situ solids in Pond 18 as of 2002 based on column testing of solids sampled from the pond were on the order of 8x10⁻⁵ cm/sec for the modeled pre-dewatering case and $3x10^{-5}$ cm/sec for the in-pond consolidation model. These estimated vertical hydraulic conductivities of undisturbed solids appear generally consistent with the bulk unit weight and fine-grained nature of the solids. Given the approximately five (5) additional months that water has been routed around Pond 18 recently, it is possible that some additional consolidation and settlement has occurred, and that the current vertical hydraulic conductivity may be somewhat lower. These laboratory-based estimates have also been compared to an estimate made by proportioning the total previously estimated seepage from all active ponds from Pond 18 through Pond 5 (estimated by a mass balance calculation of surface flows and evaporation as approximately 250 gpm or 0.56 cfs) to each pond based on its bottom area. On this basis, the back-calculated overall average vertical permeability (K_v) for the Pond 18 solids would be on the order of 1 x 10⁻⁵ cm/sec. Given that this mass-balance derived estimate includes the lower Ponds 9 through 5 with little to no visible solids, it is not unreasonable to estimate that the actual average vertical permeability of the Pond 18 solids on this basis would be somewhat lower.

2.0 Solids Removal

Two primary alternatives will be evaluated and tested in the field to arrive at one or more acceptable procedures to remove and transport solids from Pond 18 to the interim drying facility. The information gathered during the Pond 18 removal in the summer of 2011 will serve as the initial basis for selection of the removal method(s) for the other upper ponds during 2012-2013, with any necessary and appropriate revisions due to pond-specific conditions that are encountered during the actual removals.

The first alternative is use of conventional earthmoving equipment, which is believed most suitable for solids to be excavated above the groundwater table at the time of removal based on pilot scale investigations conducted in 2001-2002. This alternative will involve the following steps:

- 1) Route incoming flow around Pond 18 to the next downgradient pond in the flow path (Pond 15) (this step was completed in fall, 2010).
- 2) Decant and pump off remaining surface water from Pond 18 to allow additional solids consolidation in-place for as long as the overall construction schedule would allow (completed in fall 2010); pump snowmelt and precipitation accumulated since fall 2010 to Pond 15 prior to commencing removal in 2011.
- 3) Excavate solids with conventional earthmoving equipment, likely including a low ground pressure tracked excavator with extended boom reach and possibly a rubber tire or tracked loader; swamp pads and/or earthen causeways may be required to access and facilitate controlled removal of solids.
- 4) Haul solids by truck and/or loader to the interim drying facility.
- 5) Deposit and spread solids in drying cells at the interim drying facility, likely using a small dozer and possibly a small conventional loader and/or skid-steer loader.

It is proposed to leave approximately two (2) feet of solids undisturbed in the bottom of Pond 18 to limit seepage loss to the underlying predominantly coarse-grained alluvial aquifer. Based on the available information from the 2001 investigation described previously and recent survey of the current top of the solids, it is estimated that approximately 5,000 cy of the 13,000 cy in Pond 18 will be left in place. Special care will be taken by means and methods to be determined in the field to minimize to the extent practical over-excavation of the solids to remain in place.

Secondly, a dredging alternative will be evaluated. This alternative would involve:

- 1) Route incoming flow around Pond 18 to enter Pond 15, and decant ponded water from Pond 18 (already completed at Pond 18 in fall 2010); pump snowmelt and precipitation accumulated since fall 2010 to Pond 15 prior to commencing removal in 2011.
- 2) Dredge solids with a suction dredge with an appropriately designed, continuously agitating suction head to counteract the apparent thixotropic-like behaviour (i.e., tendency for solids to behave as a solid versus as a slurry in the absence of constant agitation) observed during the 2001-2002 pilot scale dewatering and removal exercise at Pond 18; add water if/as necessary at suction head to create pumpable slurry.
- 3) Convey solids via pipeline to one or more of the proposed cells in the interim drying facility, with special attention to maintaining continuous flow to mitigate the apparent thixotropic-like behaviour.

If/as necessary to develop and prove the feasibility of the dredging alternative, a dredging contractor would be engaged to perform field-scale trial removal from Pond 18, and possibly one or more of the other upper ponds to avoid a second mobilization and trial of this more specialized equipment. As in the case of the conventional excavation method, approximately two (2) feet of sediment will be left undisturbed in the bottom of Pond 18. Again, special care will be exercised to develop a means to ensure that disturbance of the solids to remain is minimized to maintain their lining effect.

3.0 Interim Drying Facility

3.1 Siting

The available open ground in the former Pond 16/17 area is planned to be used for the interim drying of solids removed from Pond 18 as shown on Figure 2. This location is strongly preferred considering:

- Close proximity to Pond 18 and the other upper ponds containing the majority of the solids to be processed limits haul distances and/or pumping distances (depending on the method of removal required);
- Existing accessibility to both conventional equipment for cell construction and solids placement and piping for dredge discharge;
- Surface grade is above the seasonal high groundwater level so that downward drainage of the placed wet solids will not be impeded by underlying groundwater;

- Sufficient gently sloping ground is present for placement of Pond 18 solids in a relatively thin layer to promote more rapid and efficient drainage and consolidation;
- Existing ground generally slopes in an advantageous direction to promote drainage of dewatering water along the base of the placed solids (to the extent that it does not infiltrate the subgrade); and
- Available grade is present for gravity conveyance of dewatered pore water from the consolidating solids to Pond 15 in the active ponds system.

Use of this interim facility for drying of solids removed from Ponds 11 through 15 during 2012-2013 will be considered depending on the performance observed during 2011 and on later decisions regarding the layout and design of the ponds treatment system primary settling pond and the solids repository. The potential to convert an interim drying facility at this location to a permanent facility is also considered feasible based on information and evaluations to date.

Alternative locations for the interim drying facility were considered, but determined less feasible than the Pond 16/17 area. These locations include the relatively open flat area north of Pond 18 and the currently off-line Pond 13. Disadvantages of the north area site as compared to the Pond 16/17 site include: 1) having to haul and/or pump removed solids considerably further and upslope by about 6-18 feet more; 2) the need to completely encircle the site with a containment dike; and 3) significantly more grading of the subgrade to promote gravity drainage of non-infiltrating dewatering water to a down-gradient sump. The Pond 13 alternative site is seasonally submerged by an estimated 1 to 2 feet of water and contains existing solids and possibly calcine tailings. It is not feasible to evaluate and design for these conditions in the timeframe available for completion of the interim drying facility to receive Pond 18 solids in 2011. If necessary based on later decisions regarding the layout and design of the ponds treatment system primary settling pond and the solids repository, one or both of these sites could be further considered during siting and design of the permanent drying facility.

3.2 Interim Drying Facility Layout

As shown on Figure 3, the combined Pond 16/17 area will be subdivided into several cells (four shown). Each cell will have a different design and operation that will allow for evaluation of drying technologies for a permanent facility. The cells will be set back and isolated from Ponds 18, 15 and 13 with an earthen containment dike/access road. This access would be used for solids hauling/placing, and also for future repairs/upgrades if/as needed to the existing adjacent upper pond embankments. Compacted earth dikes will be used to enclose and divide the cells, which will be sized for height to accommodate the solids removed from Pond 18 (and possibly later from the other upper ponds as necessary pending construction of a permanent drying facility), with sufficient freeboard to accommodate direct precipitation (rainfall and snowmelt). Stormwater run-on will be intercepted in a ditch/berm around the upslope limits of the drying facility and conveyed to the ponds system.

The Pond 16/17 area generally consists of approximately one (1) foot of random rock fill over 15 to 25 feet of calcine tailings from historical pyrite ore processing activities. The rock fill and any other materials or debris present in the footprint of the drying facility will be removed. The area of each cell will be graded to drain generally from northeast to southwest,

to a sump that will be used to collect gravity-induced drainage from the placed solids that does not directly infiltrate the underlying calcine tailings (if any) and direct precipitation, which will in turn be conveyed by gravity or pumping to Pond 15 (see Figures 3 and 4).

3.3 Drying Cell Conceptual Design and Operation

It is expected that there will be four (4) cells in the interim drying facility, divided by earthen berms, with access by vehicles provided to each cell. The design of each cell varies to provide for evaluation of different drying cell procedures for the permanent drying facility design. The actual number, configuration and purpose of each of the proposed individual drying cells may change during the course of the Pond 18 solids removal based on the characteristics of the solids at the time they are removed. Adjustments to the initial layout, configuration and operation of the cells will be made, with EPA concurrence, if/as necessary in response to ongoing evaluation of the removal and drying facility operations and performance. The initial four (4)-cell concept is provided on Figure 3 and its construction and operation is further described as follows:

- Drying Cell 1 would consist of a perimeter dike with bottom surface graded in the existing calcine tailings. Solids would be placed directly on the calcine tailings with no underlying placed filter or drainage media. Once placed the solids would be left undisturbed until the maximum practical dewatering and consolidation by evaporation and downward drainage had occurred.
- Drying Cell 2 would be constructed and operated consistent with Cell 1, except that the solids would be periodically tilled to promote evaporative drying.
- Drying Cell 3 would include a perimeter dike with graded bottom surface on calcine tailings that is subsequently covered with a layer of gravel to provide a high efficiency drainage media to promote downward gravity drainage of pore water from the overlying solids into and then laterally through this highly permeable drainage layer. This concept would also test the tendency for the solids to "pipe" (internally erode) into the open voids in the gravel blanket. The gravel layer would be connected to the sump at the low point of the cell.
- Drying Cell 4 would be designed and operated as for Cell 3 except that a graded soil filter would be placed between the overlying solids and the underlying gravel blanket. If the filter layer acts to prevent piping of the solids into the gravel drain, but clogs in the process, then means and methods to efficiently remove and replace the filter during operation of the facility would be evaluated.

The height of the perimeter dikes will be set to minimize to the extent practical both the depth of solids to promote more rapid and efficient drying and the plan area necessary to devote to solids drying. The footprint area and slopes of the new perimeter dikes will be set based on bearing capacity and settlement considerations of the calcine tailings foundation material, as well as stability requirements based on the nature of the embankment borrow sources (whether on- or off-site) relative to stormwater, precipitation, and seepage considerations. The drainage media (gravel layer and soil filter, where placed) will be designed based on hydraulic requirements to carry the required flows, and filter criteria to mitigate piping while maintaining adequate permeability. Details of the design and construction of the interim drying cells may vary depending on whether the solids are

conveyed and placed by conventional earthmoving equipment or by suction dredge and pipeline.

4.0 Evaluation of Removal Methods and Drying Cell Performance

The means and methods utilized to remove and transport/convey solids from Pond 18 to the interim drying facility will be thoroughly documented with field notes and digital photographs and video. The volume of solids removed and the depth of solids left in place will be tracked by survey/direct measurements (if safe access can be made) and/or load counts (if removed and transported by conventional earthmoving equipment) or pipe discharge measurement (if removed by dredge and conveyed by pipe).

The purpose of the multi-cell approach to the interim drying facility is to evaluate, on a field scale, the most expedient method(s) for enhanced consolidation/drying of the precipitated solids, which can then be applied, as appropriate, to future solids removal from the other upper ponds and long-term management of solids generated during operation of the overall treatment system. It is anticipated that the solids drying performance of the interim drying facility will be evaluated for key parameters using a combination of the following techniques:

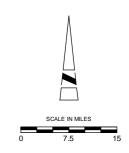
- *Solids Drying Time*: Periodic measurement of the approximate depth of sediment in the drying cells, indicative of the amount and time required for consolidation. Drying will be observed throughout the initial few months after solids are placed in the drying cells, as well as possibly observed in 2012 for up to a year after placement.
- Solids Physical Characteristics Over Time: Recovery of Shelby tube samples of the sediment from each cell, for laboratory evaluation of moisture content, density, shear strength, hydraulic conductivity and consolidation changes over time. These parameters will be key input data for design of the permanent drying facility and solids repository.
- Drying Performance of Different Cells: Excavation of test pits and observations of the gravel drain and earthen filter layers, where used, to assess potential for piping and clogging of these materials, and the resultant reduction in drainage efficiency of the overlying solids.
- Drainage Water Characterization: Evaluation of the approximate volume and character of drainage discharged from the drying cells to Pond 15. This information will assist in understanding how to manage this water, and assist design of the future water treatment facilities.
- Dust Potential and Control Options: An ongoing assessment will also be made of the potential for dust being generated during the solids drying, and the need for control of dust from the solids. The surface of the solids in the drying cells will be treated either with a light water spray, a suitable dust suppressant, or mixed/turned over with the underlying wetter solids, if/as necessary.

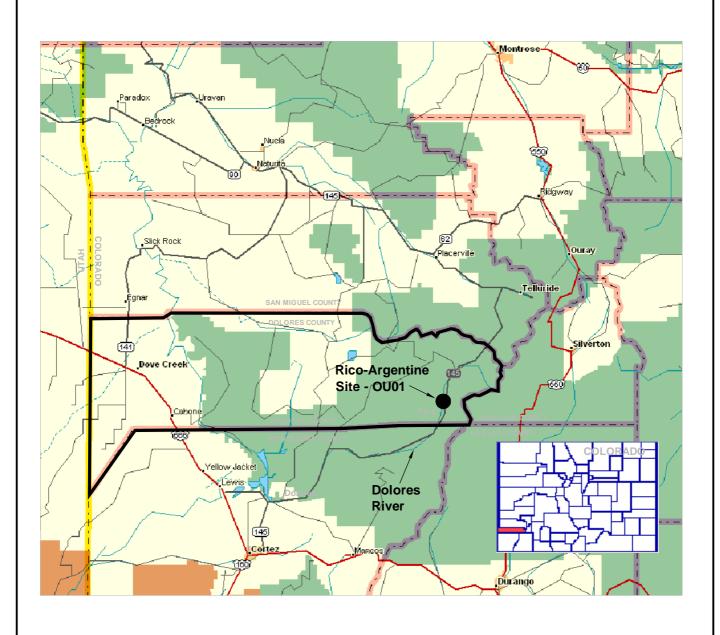
5.0 Schedule and Oversight

A request has been made to revise the date of mobilization to the site to begin work to implement the Initial Solids Removal Plan from June 6 to July 2, 2011 to allow for additional in pond consolidation and settlement. However, AR is prepared to initiate mobilization as of the original date of June 6 if necessary. Removal of sediment from Pond 18 will commence in mid to late summer 2011, following approval and construction of the interim drying facility. Removal of Pond 18 solids to the interim drying facility will likely be completed by late summer, but no later than December 1, 2011. In accordance with the requirements in the Removal Action Work Plan, the solids removed from Pond 18 will be placed in a new on-site solids repository by no later than December 2013. Removal of solids from the remaining upper ponds will be performed between July 2012 and December 2013. It is anticipated that these removals will be performed as early during this period as practical to allow for the greatest degree of consolidation dewatering (and resultant drying) of the solids as feasible. Following adequate drying, these existing solids will be placed into the solids repository between July 2013 and December 2014.

The activities of selected construction contractor(s) will be overseen by Atlantic Richfield representatives on a full-time, on-site basis. Depending on actual conditions encountered, appropriate adjustments in the sequence and/or the means and methods of removal may be identified. Any such adjustments will be presented to EPA for timely review and approval, and upon approval, implemented by the construction contractor.

In addition to observing the quality of the work, Atlantic Richfield field oversight and design team members will also implement the activities described previously to evaluate performance of the initial removal and interim drying operations.





AECOM

AECOM Technical Services, Inc. 717 17th ST., SUITE 2600 DENVER, COLORADO 80202 T 303.228.3000 F 303.228.3001 www.gecom.com RICO-ARGENTINE SITE - OU01 INITIAL SOLIDS REMOVAL PLAN

LOCATION MAP

AECOM PROJECT NO.

60157757

FIGURE

1

